CONTRACT DA 18-035-AMC 275 (A)*

FIRST MONTHLY PROGRESS REPORT

COVERING THE PERIOD

1 JULY 1964 THROUGH 31 JULY 1964

COLLECTIVE PROTECTION FOR COMMAND POST VEHICLES

Contract No. DA 18-035-AMC-275(A)

Prepared for

United States Army Edgewood Arsenal,

Edgewood Arsenal, Maryland

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Contract DA18-035-AMC 275(A)

1st Monthly Progress Report

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Feasibility Study of
Collective Protection for Command Post Vehicles

17 August 1964

Copy 17 of 50 copies

TABLE OF CONTENTS

LIST OF FIGURES

I. INTRODUCTION

This Contract deals with feasibility and design studies of Collective Protection for Command Post Vehicles. The vehicles under investigation are:

M113 Armored Personnel Carrier
M577 Armored Command Post Vehicle
M292 Expansible Van Truck

The contract objective in Phase I is to determine if it is feasible to pressurize said vehicles within known-state-of-the-art for Positive Collective Protection. The air flow capacity required for providing collective protection will be determined by a study of the category of protection required (with or without exit-entry system), number of personnel occupying the vehicle, air leakage into and within the vehicle at the over pressure required for protection and the requirement for heating and cooling the air. Further, in this regard the primary mission of each vehicle can in no way be impaired by the addition of a collective protection system.

Consideration must be given for the secondary mission that may be assigned to these vehicles. It is intended to determine the feasibility of applying integral positive pressure type of collective protection to these vehicles in order that they may be used in contaminated atmospheric environment by personnel not wearing protective masks or clothing under conditions of one or more of the following categories:

1. Troop Rest and Relief Station
2. Medical Aid Station
3. Command Post
4. Fire Direction Center

II. SUMMARY

First month work consisted of preliminary meetings with CRDL; literature search of state-of-the-art concepts at CRDL Library; vehicle access arrangements made at Fort Knox, Ky. and CRDL; preliminary air flow test on air lock; design and fabrication of leakage test apparatus and adapters; U.S. Government Property Manual, prepared, submitted and approved by Government Property Administrator.

III. WORK EFFORT

The specific period of Phase I - tentatively the 1st quarter - (1 July 1964 to 30 September 1964) has been broken down into 34 specific tasks. Of these, approximately 12 have been activated during this first month activation period.

TASK	DESCRIPTION	% COMPLETED	% DUE 1st PERIOD
106	Preliminary Conferences with CRDL, AIAC, Etc.	100	100
108	Project Facilities Activated	100	100
109	Security Indoctrination Meeting	10	10
111	Field-of-Interest Register Cleared	100	100
117	Literature Search at DDC, CRDL	100	100
118	M113 Vehicle Access Arranged	100	70
119	M577 Vehicle Access Arranged	0	70
120	M292 Vehicle Access Arranged	100	70
122	M113 Leakage Test Adapters Made	100	0
123	M577 Leakage Test Adapters Made	100	0
124	M292 Leakage Test Adapters Made	100	0
125	Air Lock Flow Test Facility Assembled	100	100

TASK DUE DURING 2nd PERIOD

129	M113 Leakage Studies Completed
130	M577 Leakage Studies Completed
131	M292 Leakage Studies Completed
132	Air Lock Flow Studies Completed
134	Motor-Blowers Analyzed
135	Air Cleaners Analyzed
136	Particulate Filters Analyzed
137	Gas Filters Analyzed

140 CPS Categories Established (3 Vehicles)

141 Filter Unit General Design

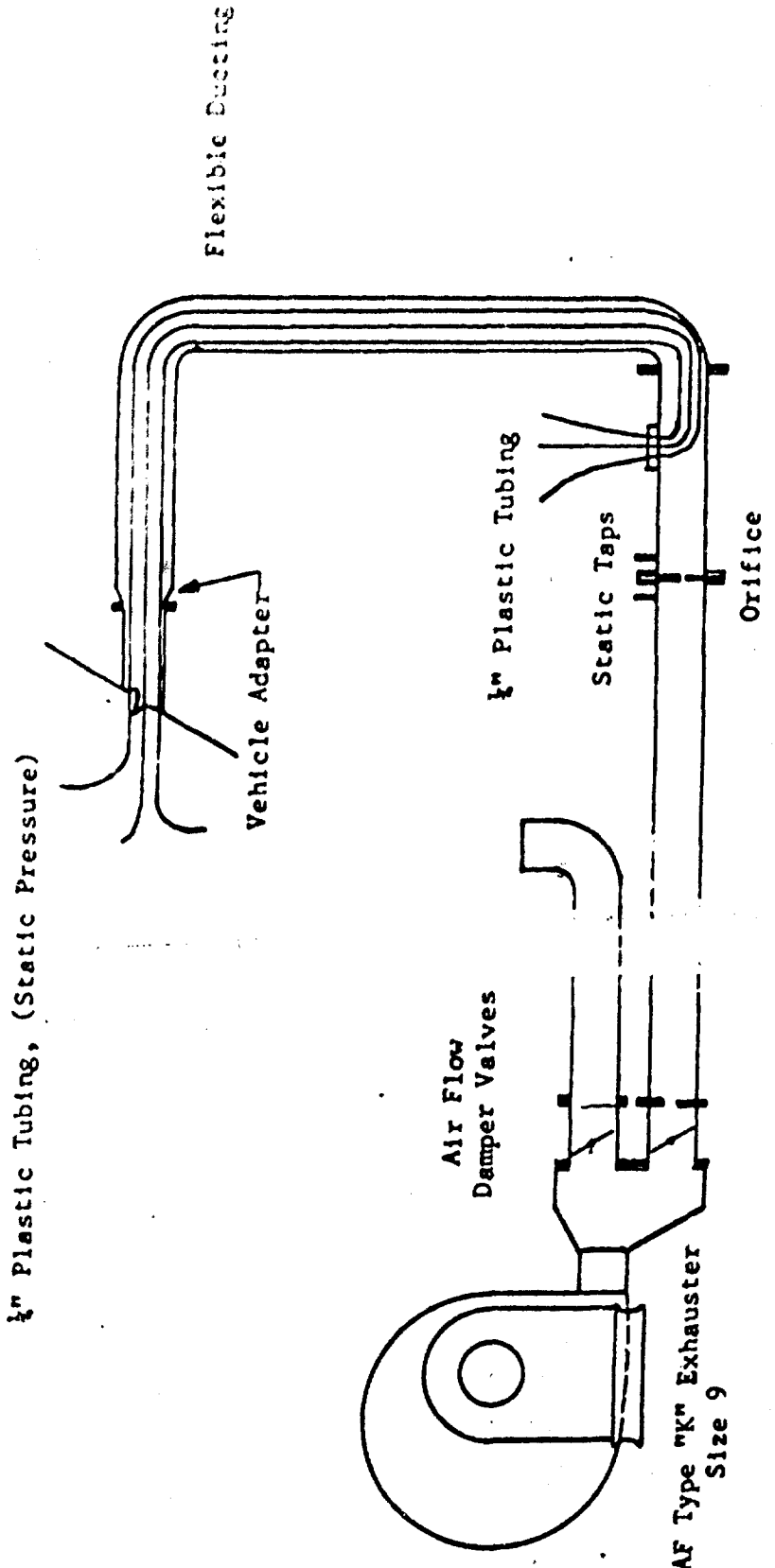
IV. LEAKAGE TEST APPARATUS AND ADAPTERS

The leakage test apparatus consists of an AAF Type "K" Exhauster - size 9, powered by a 3 phase Multi Voltage 3 H.P. electric motor. The system is capable of producing 1400 CFM at 8" S.P. and as low as 1 CFM. Design of apparatus incorporated a quick disconnect for easy orifice removal plus aligning pins in orifice flange placed in an unsymmetrical location, thereby making it impossible to place a sharp edge orifice into the air-flow duct incorrectly. Measurement of S.P. within the vehicles was accomplished without any drilling, taping or modifying any aperture on or in said vehicle by introducing ¼" plastic tubing into the vehicle via the 8" flexible ducting. The ¼" plastic tubing was color coded for ease of identifying location of resultant pressure differentials within vehicle under test.

A series of sharp edge orifices were fabricated from 10 ga. stainless steel according to ASME Power Test Code PTC M.5; 4-1959, Page 9. Coefficient of discharge was calculated according to American Society of Mechanical Engineers, Vol. 44, 1922. The orifices were selected to be operated at from 1" to 3" orifice pressure differential. By operating at a one inch orifice pressure differential or greater, the error of measurement of air flow is greatly minimized. These orifices will be calibrated and the calculated coefficient of discharge verified. Phase I of PERT network has been revised and will be submitted prior to the 2nd monthly report.

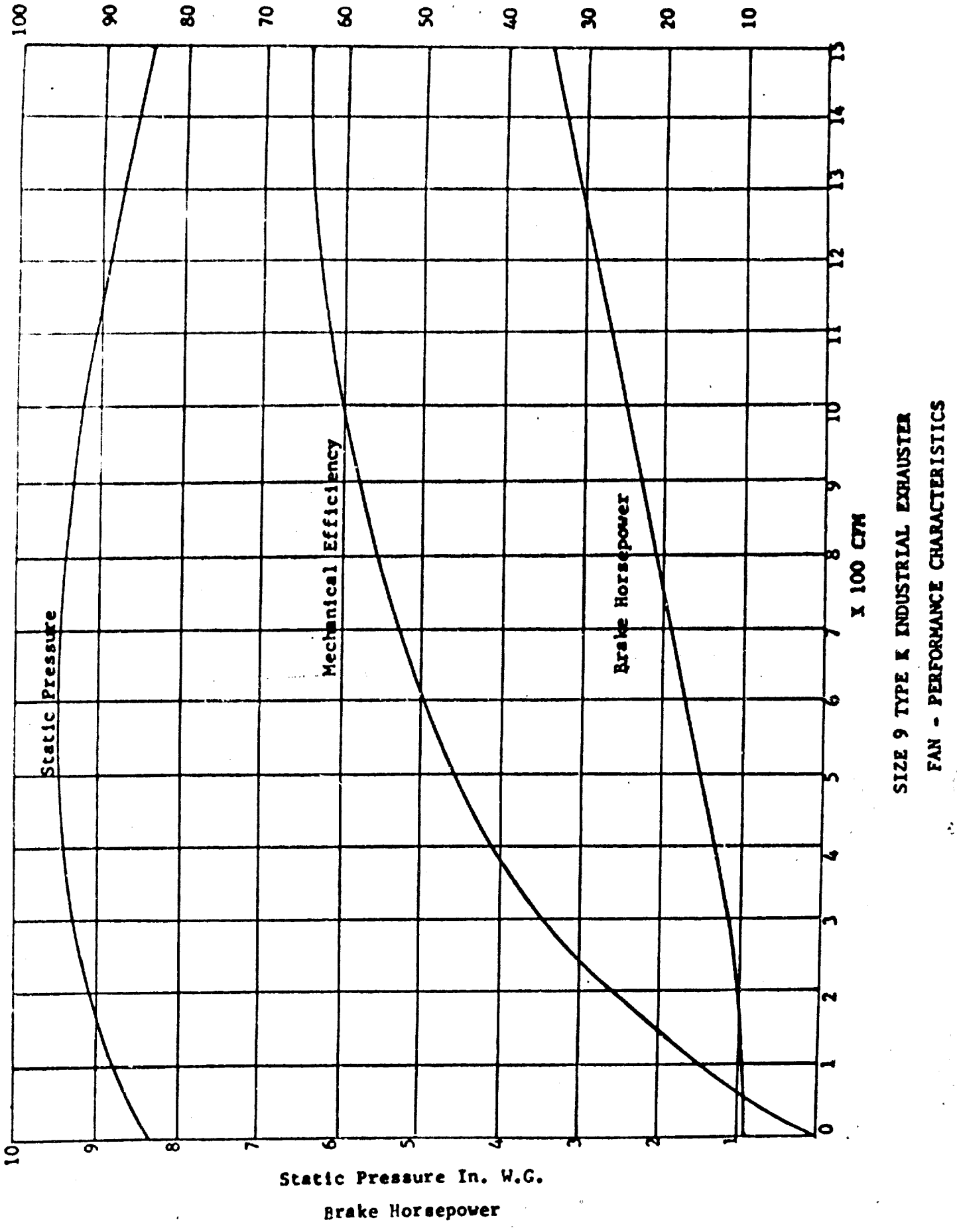
It is anticipated that Phase I will be completed on schedule.

Figure 1



PRESSURIZATION TEST APPARATUS

Figure 2



SIZE 9 TYPE K INDUSTRIAL EXHAUSTER
FAN - PERFORMANCE CHARACTERISTICS
AT 2950 RPM

FIGURE #3

ORIFICE SIZES

CFM @ 1" OPD	CFM @ 3" OPD	Orifice Area, in Ft^2	Orifice Diameter in Inches	Orifice Coefficient of Discharge
1.0	1.717	.0004C	.27343	.6090
1.6	2.77	.000644	.34375	.6090
2.5	4.34	.00101	.42968	.6090
4.0	6.93	.00162	.54687	.6090
6.5	11.25	.00267	.70000	.6090
10.0	17.17	.00410	.86718	.6090
15.0	26.0	.00615	1.06250	.6090
23.0	39.9	.00946	1.31445	.6100
35.0	60.7	.01425	1.61718	.6110
55.0	95.4	.02250	2.03125	.6120
90.0	155.9	.03580	2.56250	.6140
140.0	243.0	.05550	3.18750	.6200
220.0	382.0	.08730	4.00000	.6340
350.0	607.0	.08800	4.90625	.6680
540.0	936.0	.1840	5.75000	.7350
850.0	1475.0	.2170	6.68750	.8960
1200.0	2080.0			

AIR FLOW CALCULATION

" Pipe	A_2/A_1	C	Cr
	.1	.614	.8783
	.2	.6249	.7752
	.3	.6441	.6745
	.4	.6723	.5853
	.5	.7124	.5052
	.6	.7702	.4261
	.7	.8611	.3568

Assuming standard air:

$$Q = 4005 \; CA\sqrt{OPD}$$

Where C - coefficient of discharge
Q - cubic feet of air per minute
OPD - orifice pressure differential
A - area of orifice in Ft^2

Other abbreviations involved in air flow calculations are as follows:

Cr - coefficient of resistance

A_2/A_1 - area ratio

A_1 - pipe area in Ft^2
.3380 Ft^2 for pipe with 7.875 in. diameter

A_2 - orifice area in Ft^2